Sir George Cayley (1773-1857)
The Father of Aerial Navigation

"...the whole problem is confined within these limits, viz. To make a surface support a given weight, by the application of power to the resistance of air."
The National Soaring Museum is approaching its 25th anniversary, and when one looks back on what has been accomplished, it is impressive — even breath-taking. Originally conceived by a group of Harris Hill soaring enthusiasts and endorsed by the Soaring Society of America, the Museum has grown from a modest beginning at the Merrill House with a collection of only 40 sailplanes to a modern exhibit, restoration, and storage facility whose collection includes over 60 ships — the largest collection of vintage and modern sailplanes in the world.

As a result of this distinguished and unique collection, the Museum has become a national cultural treasure whose archives, artifacts, and library preserve for all generations to come the history, science, and traditions of motorless flight.

And we’re planning for the future now — not only with a forward-looking schedule of new exhibits, commemorative celebrations, and educational programs, but also with a program to ensure the future financial well-being of the museum with which we’ve been entrusted.

The Planned and Major Gifts program, while supporting the Museum’s future security, can also offer you current financial benefits within your own estate and financial plan.

Your Benefits
- Planned Giving can enhance your retirement benefits with additional lifetime income agreements for your second person if you like.
- Planned Giving can increase your current income.
- Planned Giving can increase your current assets by decreasing your income tax obligations.
- Planned Giving can offer special planning options that allow you to avoid capital gains tax in the management of appreciated property.
- Planned Giving can increase the size of the estate you leave to your children.
- Planned Giving allows you and your family to become forever associated with the perpetuation of our national soaring heritage.

The Planned Giving Options
The two most widely used plans are gifts to establish Lifetime Income Agreements and gifts by Will or Revocable Trust.

Lifetime Income Agreements
This is an agreement in which you can make a saleable cash or capital asset gift to the Museum and reserve lifetime income for you and/or another person. The Charitable Remainder Unitrust and the Charitable Remainder Annuity Trust are two common examples of this agreement. Both are available if you would like more information about either of these agreements. Gifts by Will or Revocable Trust is perhaps the most common planned gift. You can make a provision for the future of the Museum while at the same time receiving income for you and your family and the full ownership and use of your assets. When your will is probated, the amount of the bequest provides you with an estate tax deduction.

NSM’s Advancement Director, Michael Zimko, considers the graphic of Cayley’s man-carrying glider as one of the options for a Museum pin honoring membership in the Cayley Society.

The Museum’s Advancement Office can assist you with suggested wording:
A gift by Revocable Trust works in a similar way except that you, some other individual, or some institution acts as the trustee of your assets until they are distributed. Many people choose this vehicle, because it allows them the privacy of bypassing probate. Brochures on either of these gift methods are available on request.

There are other options which the Museum will discuss in detail in the renewed publication of Molt, now entirely devoted to timely articles on planned giving.

Your Recognition
In memory of the Father of Aerial Navigation, Sir George Cayley, the Trustees of the Museum have established a society to honor all those who make a planned gift, or who make an outright gift of $50,000 to the Endowment, whether as a single gift or as multiple gifts whose cumulative value equals $50,000. You may establish an endowment fund, in your name or the name of someone you wish to remember or honor, to support specific aspects of the Museum’s mission such as archives, education, or restoration. You may make a general gift to the Endowment, or you may choose to make the gift with absolutely no restrictions.

As the national treasure of soaring, the Museum is grateful for your support.

Sir George Cayley, the 6th baronet in the family line was born in Scarborough, Yorkshire in 1773. (1)

Charles Dottin, a modern French authority, referred to him as, “The true inventor of the aeroplane and one of the most powerful geniuses in the history of aviation.” (2)

He expressed his conviction that human flight required less force than might have been supposed and he categorically rejected the concept of using beating wings to produce lift. In 1809 he wrote in Nicholson’s Journal of Philosophy, “...the whole problem is confined within these limits, viz. to make a surface support a given weight, by the application of power to the resistance of air.” (3)

While many gifted visionaries, experimenters, exhibitionists and tinkers preceded Cayley, most failed to even understand the problems they were attempting to solve. Through the centuries some hand-won aeronautical celebrations were recorded, but would-be aeronauts rarely bothered to find out what their predecessors had accomplished, and progress was diametrically slow. (4)

Cayley’s 1796 helicopter design. The opposite-rotating rotors were made of feathers slung into corcks and activated with a bow string. A similar device was tested in 1784 by Launoy and Bienneu.

The ten-year-old Cayley was enthralled when he learned of the Montgolfier Brothers’ first hot air balloons in 1783. He began to construct his own flying machines by making a small toy helicopter in which two rotors, consisting of feathers stuck in corcks, were driven by a bow string. Unknown to Cayley, a similar device had been demonstrated at Paris in 1784, before the Academy of Sciences by Launoy and Bienneu.

By 1796 he had advanced far enough to engrave a small silver disc showing the forces of lift, thrust and drag acting on a wing surface. On the reverse he engraved an illustrated sketch, in perspective, of a fixed wing glider with a fuselage below containing a pilot. The device had a tail unit of horizontal and vertical control surfaces and a set of manually operated flappers for propulsion. As Charles H. Gibbs-Smith commented, “We have here, in the last 18th century, the aeroplane of today in embryo; it marks the start of a new epoch and the true beginning of practical aviation.” (5)

Cayley built a whirling arm apparatus in 1804 that enabled him to study the air pressure on a one-foot-square plate set at various angles of incidence.

With his recognition of the true significance of the kite, later that same year Cayley constructed history’s first successful airplane. It was a five-foot-long model glider with a kite-like wing set at a 6 degree angle of incidence, mounted on a pole. The cruciform tail unit was attached by a universal joint to act as a shifting rudder and elevator control. The model had a movable fore and aft to adjust the center of gravity. (2)

In 1809, he constructed and successfully flew a full-scale glider with a wing area of 200 feet. Cayley actually tested this ship carrying a young boy for a few yards at a time on his Brompton Hall estate. His experiments led him to conclude that curved surfaces produced more lift than flat ones, the curvature creating lower pressure.

Engraved on a silver disc by Cayley, in 1799, this is regarded as the first design for an aeroplane with wing, fuselage, tail unit and a means of propulsion (paddles) divorced from the lifting system.

There is general agreement among aeronautical historians that Cayley was the first to investigate the possibilities of flight from a strictly engineering and scientific perspective. He knew that the secrets of flight lay in the nature of air itself. He understood that air offered varied and measurable resistance to objects moving through it. He knew that its density was not constant and great unseen currents and eddies existed. (4)

This seemingly limitless element supported bats, insects and birds; he set out to show that it could support humankind as well. Before he died in 1857, at the age of 84, Cayley had discovered the basic principles on which the modern science of aeronautics was founded, built what is recognized as the first successful flying model glider, anticipated the airship and the present-day convertible, and built and tested the first man-carrying flying machine. (5)

Please send me more information about the Cayley Society and the Museum’s Planned and Major Gifts program.

I am especially interested in

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Michael Zimko, Advancement Director
National Soaring Museum
Einhr, NY 14403
(607) 734-3212

Cayley’s drawing of his 1799 fixed wing design, the first modern configuration aeroplane.

Sketch of whirling arm for testing airfoils.

Continued on Page 4
above the wing. He also suggested that superimposed wings (biplanes and triplanes) would increase lift with minimum structure weight. He showed with great clarity the advantage of building wings with a dished rib (a flat vee from the front view) for lateral stability.

In 1843 Cayley designed a convertiplane arrangement based on the drawings of Robert Taylor. According to historian Gibbs-Smith, Cayley turned Taylor’s convertiplane into history’s first biplane and the first two-air screw design. (1)

He constructed many subsequent models and, in 1849, built a full-size triplane glider that was launched free in a basket, and later flown (and towed) by a boy aboard.

In 1853, according to a story told by his grandson, Cayley invented his very reluctantly companion to making a triplan glider flying across a shallow valley and jumping down in a cloud of dust. “Please, Sir George,” the distraught driver/plot shouted, “I wish to give notice: I was hired to drive not to fly.” (4)

The relatively Yorkerian banower’s inaction was not restricted to matters or flight alone. Gibbs-Smith says that Cayley, “relished and invented in many other fields, mechanical and social, such as land reclamation, unemployment relief, artificial limbs, theater architecture, railways, boats, products, optics and electricity.

Some of his applied science inventions include the tussion-wired, the expansion air engine (the hot-air engine) and the cataract tractor.

Cayley found time to write poetry, and served for a short time as Member of Parliament for Scarborough.

Sir George Cayley is the great-great-grandfather of the present Duchess of Kent (née Katharine Worsley). (2)

The N.S.M’s Sir George Cayley Society is well-named as the recognition of these donors whose gifts are planned for the future development and support of the Museum. It is only fitting that we remember the first true astronaut as we plan for the preservation of the heritage of notoriety flight.

Those wishing more information on the fascinating and little-known historical figure may wish to read the well-illustrated: “Sir George Cayley Aeronautics 1790-1855” by Charles H. Gibbs-Smith.


(1) Aviation - An Historical Survey From the Origins to the End of WWI, Charles H. Gibbs-Smith

(2) Aviation, the Pioneer Years, researched and edited by Ben Macmillan - Read 1990.


(5) The Lore of Flight, advisor and supervising editor John W. R. Taylor

(6) See page 21

(7) Incidence - the angle formed between the chord line of an airfoil and the longitudinal axis of the body supporting the surface.

Cayley 1849 Glider advanced design for the tension-wired point.
duce. Horace did not specifically recall the spectacular 9-minute and 45-second flight because Ovville's log showed that it was just one of over 20 that day. However, Horace or "Buster" as the family nick named him, did have a very clear and colorful memory of the events of the October 10-27, 1917, Kitty Hawk expedition.

The Schweizer invited Mr. and Mrs. Wright, along with the National Air and Space Museum's founder and Curator Emeritus, Dr. Paul E. Garber (since deceased) and Dr. Tom D. Crouch, now Chairman of the N.A.S.M.'s Department of Aeronautics to come to Harris Hill for the October 1988, N.S.M. 1911 Glider #5 exhibit and celebration.

Arrangements were made through the Coming Glass Aviation Department to have its jet fly the Wrights to Elmira and return. "This was one of the biggest thrills of their lives," Paul said, "...and as a result, Horace said that the remaining major piece of the 1903 Flyer fabric, decided to give to the N.S.M. Unfortunately, before he could do this, he passed away."

His will advised the N.S.M. of her late husband's wishes and asked that a museum representative go there to pick up the fabric because it was much too valuable to ship through regular channels.

The Exhibit Chairman continued: "A presentation was made there in Xenia and on the way back we stopped at the 50th Anniversary of the Philadelphia Glider Council where the fabric was officially turned over to Charlie Smith, our director."

Schweizer said that 90-year-old Susan Wright was unable to attend the Community Scoring Day but was pleased with the dedication.

Dr. Crouch, considered the foremost Wright Brothers authority, was next on the program. He is current Chairman of the Department of Aeronautics at the Smithsonian's National Air and Space Museum. Previously, he was Chairman of the Smithsonian's Department of Social and Cultural History of the Museum of American History; prior to that he was Curator of Engineering and Industry Division and also Associate, then Curator of Astronautics and Aeronautics at the NASM for 11 years. He has written nine books, including the 1969 prize-winning, "The Bishop's Boys - A Life with Wilbur and Ovville Wright."

Dr. Crouch is a lecturer at George Washington University, the University of Maryland and other advanced learning centers. He is responsible for many of the Air and Space Museum exhibits. "Like a lot of writers I know," Crouch chuckled, "I really say what I want to say on paper than standing at a podium. The Wrights were like that too. Ovville absolutely refused to speak in public and Wilbur was the same way." Crouch recalled an incident in 1909 when Wilbur Wright, coaxed into speaking before the Ohio Society of New York, remarked: "Well, I almost said no to this invitation, but I said yes because it was the Ohio Society. I can only think of one bird that can talk, the parrot, and parrots don't fly very well."

Crouch said that the fabric from the 1903 Flyer meant a great deal to Horace Wright. He said it was not just a piece of cloth that the Wrights wrapped over the wing ribs. Because of the wing's construction the fabric is actually an integral part of the structure of the airplane. The ribs fit inside fabric sleeves, so that the wing warps properly, thereby allowing the torsion on the wing. Without this fabric arrangement, the wing structure literally falls apart.

A slide show followed during which Dr. Crouch described the work of the pioneering aeronauts up to the time of the Wrights. He illustrated the Brothers' step by step progress from kites to the 1903 glider which was, arguably the world's first airplane. (This segment of the talk was repeated and expanded in Dr. Crouch's address given the following month at the N.S.M.'s 19th Annual Ralph S. Barnaby Lecture in Washington, D.C. Entitled "Gliders, The Route to Powered Flight," the lecture is reviewed, starting on page 9 in this journal - Ed.)
THE WRIGHT BROTHERS: SINGLE-MINDED GENIUSES

Composite photograph of the Wright family. From left: Kitty, John, Orville, Wilbur, Reuchlin, and Orville.

During a question and answer period following his talk, Dr. Crouch called the Wrights technical geniuses. "If you really want to study the process of invention, how innovation and technology work, the way it's supposed to work, study the work of the Wright Brothers." He continued, "If you want to understand how to do business, look at almost anybody but the Wright Brothers. These guys were raised by a father who had a blacksmith shop. He was a bishop in his church and created two major schisms in that church over matters that everyone else thought were minor, at best." The Brothers apparently had a very difficult time dealing with the outside world. Crouch said that their problems with Glenn H. Curtiss were, in large measure, a reflection of the difficulty they had doing business and trying to understand other people.

In answer to another question, the speaker said that the Wrights abandoned all their gliders at Kitty Hawk with the exception of the 1903 powered Flyer. "They went back to Dayton in 1903," he said. "They had only flown 800 feet. It was a sustained flight and was long enough to convince them that they had things under control. Bob Wethered used to do this comedy routine where he played the Wright brothers press agent and he would be back in Dayton talking to Wilbur down at Kitty Hawk. Wilbur was telling him about the flight and the press agent would say, 'Well, how far did you fly with... 800 feet? That's not going to cut our time to the coast by much.'"

Back in Dayton Orville and Wilbur flew as secretly as they could in 1904 and 1905. They transformed the sort of marginal success of 1903 into the really practical airplane of 1905.

Another questioner wanted to know why the Wrights abandoned their machines at Kitty Hawk if they were aware of their historical value.

Crouch responded that the Wrights were engineers. Orville and Wilbur felt that the gliders left behind at Kitty Hawk were nothing more than tools for gathering data. He added, "If we have a vision of the Wrights being like Littlefield, a romantic fellow who loved flying... The Wrights were really pretty hard-nosed and cold-blooded about this stuff... all of the information was wrong out of machine, its useful life was an end. I think we're lucky because they saved the world's first airplane... in view of their record, they might well have left it lying there on the beach, too." A query arose as to the Wrights' education. Neither finished high school. Wilbur actually completed high school but the family moved before his graduation. Their formal education didn't have much to do with it, according to the speaker. He added that the mathematical level required for the invention of the airplane was at a fairly low level. "If you've through Algebra II, you can basically deal with lift and drag problems that they faced," he said.

Dr. Crouch closed by saying, "What the Wrights needed couldn't be taught... it's that ability to image technology; to imagine a machine and know how that machine might behave through forces acting on it. That's the intuitive genius of the Wright Brothers; that and their clear ability to see problems and to define them." Judging from the comments throughout the day-long program, the First Annual Community Soaring Day was an outstanding success. Visitors left Kitty Hawk with a much better understanding of the vitality of the soaring movement and with a keen awareness of why the Tom Crouch for his description of America's motorsless flight heritage.

This 1908 photo shows the weather's effect on the Wright Brothers ahead at Kitty Hawk. The remains of the 1902 glider are in and around the shed at left.

NSM's 19th ANNUAL RALPH STANTON BARNABY LECTURE PROGRAM:

Dr. Tom E. Crouch, "Gilders - The Road To Powered Flying, 1880-1903"

1st National Gross Sky Ghost Youth Achievement Scholarship

The National Soaring Museum in conjunction with the Mid Atlantic Soaring Association hosted the 1992 19th Annual Barnaby Lecture program October 24th at Alexandria, VA. Master of ceremonies and NSM Trustee Bernard Smith welcomed the banquet audience and reviewed the background of the annual Barnaby Lectures. (See sidebar)

Begun in 1973, addresses are examinations of historic and noteworthy achievements in motorless flight by outstanding personalities in the field. They are named after the late Capt. Ralph S. Barnaby, USN, and each year the lecture is held at a different location. (NSM Quarterly, Fall 1991, Vol. 14, No. 3)

The evening's program started with the 1st National Gross Sky Ghost Youth Achievement Scholarship presentation. Dr. Frank Gross, Akron, OH, built America's first two-place, dual-control glider in 1951. The Sky Ghost. (NSM Quarterly, Summe 1985, Vol. 8, No. 1) "This 4-place glider was one of the true forerunners of the WWII cargo gliders," Bernard Smith said introducing Dr. Gross. The pioneering sailplane designer and builder presented the $500 scholarship to Kurt Aschel, Wurzburg, NY. Aschel, an engineering student at the State University of New York, Geneseo, will use the award to further his soaring activities. Gross said, "This recognition is designed to give a hand to youth in soaring. They need to be encouraged and be active. Kurt Aschel is the first national winner in a new generation of sailplane pilots." (Photo 1)
Wibur and Orville really did invent the airplane in the truest sense of the word and to do that they had to take a quantum jump beyond what anyone had done before. Crouch said emphasizing, "It is absolutely, positively rooted in gliding." He said that successful flight and the study of the human mind were born at about the same time, in the late 19th century, which the Wright brothers believed ended in the 20th. At that point, like Freud, Jung and Adler, people who were studying the human mind were fascinated by this flying machine stuff that was going on at the same time."

Crouch mentioned that Freud believed that the desire to fly was probably one of the few innate dreams that human beings have always had. It was the one gift that man could see in action all the time, birds in flight, and it was denied to humans. The scientific dream of god that flew, that's why wings were put on the great heroes of flight like Daedalus and Icarus.

The lecturer showed a slide of the history's oldest powered flying machine, a 13th century toy helicopter with string attached. Kites from China made the European debut during the 13th and 14th centuries. (Photo 4) They are closely related to gliders as aerodynamic devices and from them a great deal was learned on how to build up a powered machine. There were lots of drawings in the centuries before the Wrights, De Vinci (Photo 3) being the best known for his helicopter, parachute, and flying machine designs.

"The awful truth about all these earlier efforts," Crouch emphasized, "is that almost nothing was learned...There’s nothing for anything from those machines that's actual actual efficiency," said Crouch.

Sir George Cayley was the first to take a step in the right direction. Inventor of the first true glider, he is referred to as "The Father of Aeronautics." (See Cayley’s story in this issue.)

The Cayley glider had a lot in common with today’s airplanes. It has a separate system of control where the tail was set on an angle of incidence and had a special system for lift in its kite wing. Cayley talked about a separate propulsion system. Cayley was the first to treat lift, control and glide as required to integrate them in his designs.

"Cayley, in all likelihood, sent the first human being aloft," Crouch said.

He continued that if you were an engineer in the late 19th century and you were interested in learning how to fly, you owned David.H. You could build models and fly them. But the real stream of learning and development was with the other choice, gliding. The first flight on the rail after the last flight it was up-ended and smashed by a sudden gust. It wasn’t until the end of the 1904 flying season that the Wrights did as well as the fourth and last flight the previous year.

Toward the end of the 1905 season they were staying aloft for over one-half hour, making 25-mile flights and circling a local cow pasture repeatedly. By this time the media had taken notice and the brothers stopped and realized not to fly again until their patent came through and contracts for the sale of the plane were signed. They were on the ground until the Spring of '08, when they received their first contract. Wilbur flew in France (Photo 13) and Orville took a trip to Ft. Myers, VA. This was the year that they flew in public for the first time and were finally accepted as the inventors of the airplane.

Thereafter, they flew all over the world, established the Wright-Dayton Company, established an exhibition barn, built airplanes and opened the Wright Flyer Tourist Air Service. The Los Angeles Air Forces, learned to fly at their flying school in 1910.

After 1910-11 the Wrights began to move away from aerodynamics. Wilbur died of Typhoid Fever in 1912, but Orville kept going. Gradually his became an honorary figure, a sort of 'grand old man of aviation.'

"I guess it’s interesting to note that toward the end of his own flying career, Orville went back to flying in 1914," Crouch said. "He had built an automatic pilot device and decided to go back down to Kitty Hawk to test it with the glider. When he got down there, he decided that he was going to fly again, and he went right back to work all that well, so he just continued to glide for the fun of it."
The speaker said that during the "11 Kitty Hawk expedition, it was the (Photo 17) first time in history that an airplane really soared, gained altitude and stayed airborne for any length of time.

Orville flew powered planes after that but not to any extent. "I really think that was one of the last times he really had a good time flying," the Barnaby lecturer opined.

Dr. Crouch closed by saying, "I hope you can see how all these things are linked together and recognize the role that the glider played in the invention of powered flight."

Following the lecture, NSM president George Edwards presented Dr. Crouch with a Resolution of Appreciation from the Board of Trustees for his "...unsellfis labor and contribution of time and effort in connection with the Wright Flyer Fabric Exhibit at the National Soaring Museum and in appreciation for the delivery of the 19th Ralph S. Barnaby Lecture."

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**NSM’s Michael Ziomko With recently Acquired Nelson/Bowlus Dragonfly**

The Nelson/Bowlus Dragonfly was the first powered glider to be produced in the U.S. and was donated to the NSM by John Steen, Ada, MI.

A development of the Bowlus Baby Albatross in 1945, the first version was called the "Bumblebee."

The Dragonfly features 2-place, dual control, side-by-side seating with a fully retracted tricycle landing gear and a steerable nose wheel.

Hawley Bowlus designed it, and the marketing was sponsored by the Nelson Engine Co. as a vehicle for their 2-cycle 4-cylinder engine. The powerplant developed 25 hp at 3900.

Seven Dragonflies were built.

**Specifications**

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**The National Soaring Museum Annual Ralph S. Barnaby Lectures**

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<tr>
<th>Date</th>
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<tbody>
<tr>
<td>Oct. 23, 1973</td>
<td>Ralph S. Barnaby &quot;Barnaby Reminiscence&quot;</td>
</tr>
<tr>
<td>Oct. 5, 1974</td>
<td>Stanley W. Smith &quot;Gliders &amp; The Space Program&quot;</td>
</tr>
<tr>
<td>Oct. 29, 1976</td>
<td>Karl Striedieck &quot;1,000 Miles Along The Alleghenies&quot; Falls Church, VA</td>
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<tr>
<td>Nov. 12, 1977</td>
<td>E. J. Reeves &quot;Early Days of Soaring in Texas&quot; Dallas, TX</td>
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<tr>
<td>Sept. 9, 1978</td>
<td>Karl Striedieck &amp; Tom Smith &quot;World Gliding Championships: Chateauroux, France&quot; Elmira, NY at Dedication of the National Soaring Museum Building</td>
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<tr>
<td>Nov. 17, 1979</td>
<td>Dr. Paul McCready, Jr. &quot;The Soaring Background of the Cross Channel Man-Powered Flight of June 12, 1979&quot; Los Angeles, CA</td>
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<tr>
<td>Nov. 8, 1980</td>
<td>Dr. Richard P. Hallon &quot;Gliders in the National Air &amp; Space Museum&quot; Boston, MA</td>
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<tr>
<td>Oct. 9, 1982</td>
<td>Dr. John W. Filor &quot;The Living Atmosphere in Which We Soar&quot; NCAR, Boulder, CO</td>
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<td>Nov. 5, 1983</td>
<td>Ralph S. Barnaby &quot;The Pioneers &amp; Early Days of Soaring&quot; Princeton, NJ</td>
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<td>Nov. 10, 1984</td>
<td>Dr. Oran Nickos &quot;There's More To Come&quot; Dallas, TX</td>
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<td>Nov. 9, 1985</td>
<td>John W. Laister &quot;Kaleidoscope of Events in Jack Laister's Career&quot; St. Louis, MO</td>
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<td>Oct. 25, 1986</td>
<td>Paul E. Garber &quot;The Wright Brothers&quot; Elmira, NY</td>
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<tr>
<td>Nov. 7, 1987</td>
<td>Dr. Steven Bussolari &quot;From Myth to Reality: The Daedalus Human Powered Flight Project&quot; Seattle, WA</td>
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<td>Oct. 29, 1988</td>
<td>Paul Rudolph Opitz &quot;Development of the DFS: Rigid Tow for Cargo Gliders&quot; Hampton, VA</td>
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<td>Sept. 9, 1989</td>
<td>William S. Ivans &quot;Soaring: A World Perspective&quot; Elmira, NY at the Dedication of the National Soaring Museum Expansion</td>
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<td>Nov. 3, 1990</td>
<td>Dr. Joachim Kuettenr Colorado Springs, CO</td>
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